A. Synopsis of the Proposed Doctoral Research Work to be carried out under Visva-Bharati.

Title of the Research: Performance Assessment of Farmers Managed Minor Irrigation Systems in West Bengal

i) Name of the candidate: Subrato Gorain

ii) Name of the Guide(s): Professor *Souvik Ghosh*

iii) Registration No. : VB-1600 OF 2013-14

Date: 28.08.2017

a) Keywords: participatory irrigation management, water user association, , minor irrigation, agriculture performance, irrigation performance.

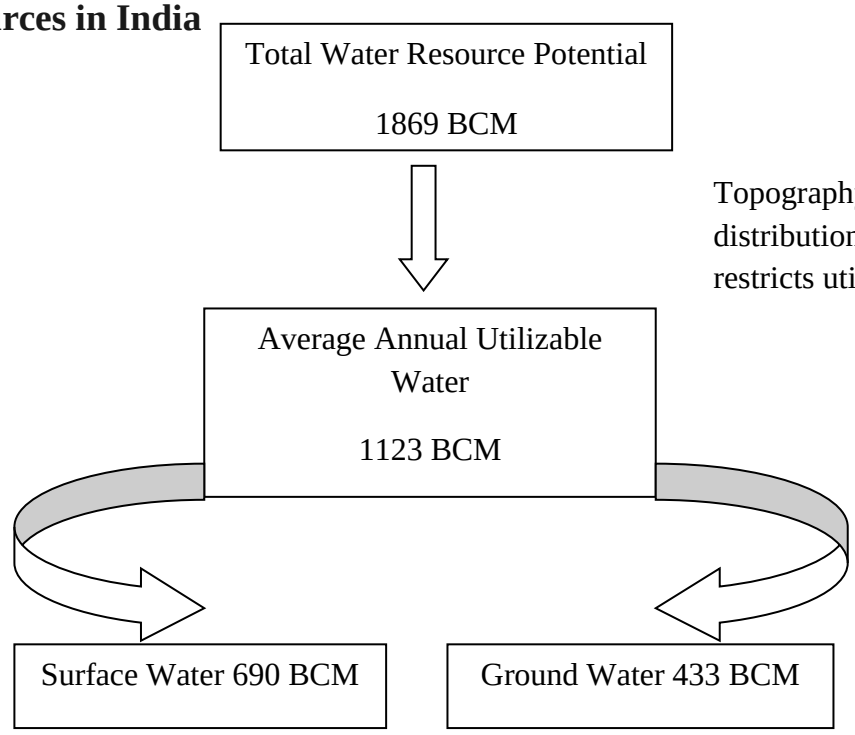
Titleof the Research: **Performance Assessment of Farmers Managed Minor Irrigation Systems in West Bengal**

INTRODUCTION

Background

Water is life because plants and animals cannot live without water. Water is needed to ensure food security, feed livestock, and take up industrial production and to conserve the biodiversity and environment. Although, India is not a water poor country, due to growing human population, severe neglect and over-exploitation of this resource, water is becoming a scarce commodity. While this is a growing concern all over the world, India is most vulnerable because of the growing demand and in-disciplined lifestyle. This calls for immediate attention by the stakeholders to make sustainable use of the available water resources to ensure better quality of lives. Globally, 70% of the earth surface is covered with water, which amounts to 1400 billion cubic kilometers. However, 97.3% of this water being sea water, it is salty. Fresh water availability is only 2.7%. Out of the total fresh water, 75.2% is frozen in ice caps and glaciers, 22.6% is stored underground and only 0.3% water is available on the surface of the earth in form of lakes and rivers and others as soil moisture and atmospheric vapour 1.9%.

Water resources in India


Total Water Resource Potential
1869 BCM
Topography constrains and uneven distribution over space and time restricts utilizable water
Average Annual Utilizable Water
1123 BCM
Surface Water 690 BCM
Ground Water 433 BCM

While water for consumption is most crucial, it is equally important to provide water for irrigation to increase the food production and liv

Source: Ministry of Water Resources, Govt. of India (2012)

increasing population. Growing population, as e

create further burden on the per capita water availability in the future.

Per capita water availability in India

Year	Population (Billion)	Per capita water availability (m^3/year)
1991	846	2209
2001	1027	1820
2025	1394	1340
2050	1640	1140

Source: Government of India, 2009.

The per capita water availability in 1991 was 2209 m^3 per year when the total population was only 846 billion. In 2001, as the population increased to 1027 billion, the per capita water availability reduced drastically to 1820 m^3 per year. By 2025, the per capita water availability will further drop down to 1341 m^3 and to 1140 m^3 in 2050. Based on the average requirement of water for various purposes, the situation is considered as water stress condition when the per capita water availability ranges from 1000 to 1700 m^3 per year and it is considered water scarcity when the availability reduces to 1000 m^3 per year. As the water available within the country varies widely as a result of rainfall, ground water reserve and proximity to river basins, most of the Indian States will have reached the water stress condition by 2020 and water scarcity condition by 2025. This would further hamper the food security, as the scarcity of water will directly suppress agricultural production.

Phases in irrigation development and management in India may be looked as follows: 1950-1970: the era of capital-intensive expansion of irrigation; 1970-1980: the era of irrigation

improvement; from late 1980s until present: the era of reform and the central challenge facing irrigated agriculture today and in the foreseeable future is more crop per drop or more crop and less drop. Irrigated agriculture in about 42% net sown area contributes to 60% of the country's food grain production. Irrigation development in India has been quite remarkable with an increase in irrigation potential from 22.6 M ha in 1950–1951 to about 123 M ha at present but irrigation efficiency (30–35%) is less than expected with a gap (32 M ha) between the potential created (123 M ha) and utilized (91 M ha) that has led to implementation of participatory irrigation management programme. The problems in irrigation sector in India are low irrigation efficiency (30-35%), deteriorating physical structures, inadequate maintenance, low cost recovery (Rs. 50 per ha against operation and maintenance requirement of Rs.250 per ha, Vaidyanathan Committee Report 1991), under-utilization (74%) of created potential, uncontrolled water delivery, tail-end water deprivation, seepage loss, siltation, waterlogging and soil salinity. As a result of the debate over non-performance of publicly supplied irrigation system, the participatory irrigation management (PIM) and irrigation management transfer (IMT) has been advocated as a solution. On the concept of people's management of developmental infrastructures that requires local solution to local problems affecting them, the National Water Policy of India (1987, 2002) stressed on farmers participation in irrigation management. Accordingly, several states in India have been implementing the PIM programmes and transferring the irrigation management to water user associations (WUA) with a view to provide equitable, timely and assured irrigation. As a result, farmers' participation in irrigation management has taken the center stage and the irrigators who were considered as beneficiaries are now considered partners in planning, development, operation and maintenance of irrigation systems (Parthasarathy, 2000). About 14.623 million hectare of irrigated land has been covered under 63167 Water User Associations in the country till the end of eleventh five year plan (Ministry of Water Resources, Govt. of India (2012). International donors like the World Bank, Asian Development Bank, European Commission and others have come forward for funding with the conditionality of PIM/IMT. Transfer of irrigation management responsibilities from government agencies to farmers is now an important policy that has resulted variable impact over space and time.

State-wise position of enactment/amendment of act

SL.NO.	Name of State	Position of issue/amendment of Irrigation Act
1	Andhra Pradesh	Enacted "Andhra Pradesh Farmers' Management of Irrigation Systems Act, March, 1997"
2	Assam	The Assam Irrigation Water Users Act 2004
3	Bihar	"The Bihar Irrigation, Flood Management and Drainage Rules, 2003" under the Bihar irrigation Act, 1997
4	Chhattisgarh	Enacted "Chhattisgarh Sinchai Prabandhan Me Krishkon Ki Bhagidari Adhiniyam, 2006".
5	Goa	Enacted "Goa Command Area Development Act 1997 (Goa Act 27 of 1997)"
6	Gujarat	Gujarat Water Users Participation Management Act, 2007
7	Karnataka	Promulgated an Ordinance on 7th June 2000 for amendment of the existing Karnataka Irrigation Act 1957.
8	Kerala	Enacted "The Kerala Irrigation and Water Conservation Act 2003".
9	Madhya Pradesh	Enacted "Madhya Pradesh Sinchai Prabandhan Me Krishkon Ki Bhagidari Adhiniyam, 1999" during September 1999.
10	Maharashtra	"The Maharashtra Management of Irrigation Systems by Farmers Act,2005"
11	Orissa	Enacted "The Orissa Pani Panchayat Act, 2002".
12	Rajasthan	Passed the "Rajasthan Sinchai Pranali Ke Prabandh Me Krishkon Ki Sahabhagita Adhiniyam, 2000".
13	Sikkim	"Sikkim Irrigation Water Tax 2002" and "Sikkim Irrigation Water Tax (Amendment) Act 2008"
14	Tamil Nadu	Enacted the "Tamil Nadu Farmers' Management of Irrigation Systems Act, 2000".
15	Uttar Pradesh	Enacted the "Uttar Pradesh Irrigation Management Act, 2009"

Source: MOWR, Govt. of India, 2012

State-wise position of WUAs and area covered by them

SL.NO	State	Number of WUAs Formed	Area Covered (000 hectare)
1	Andhra Pradesh	10800	4169.00
2	Arunachal Pradesh	39	9.02
3	Assam	720	47.04
4	Bihar	46	147.76
5	Chhattisgarh	1324	1244.56
6	Goa	57	7.01
7	Gujarat	576	96.68
8	Haryana	2800	200.00
9	Himachal Pradesh	876	35.00
10	J & K	1*	1.00*
11	Jharkhand	NA	NA
12	Karnataka	2515	1295.19
13	Kerala	4126	255.27
14	Madhya Pradesh	1687	1691.80
15	Maharashtra	1539	667.00
16	Manipur	73	49.27
17	Meghalaya	123	16.45
18	Mizoram	NA	NA
19	Nagaland	23	3.15
20	Orissa	16196	1537.92
21	Punjab	957	116.95
22	Rajasthan	506	619.65
23	Sikkim	NA	NA
24	Tamil Nadu	1310	787.96
25	Tripura	NA	NA
26	Uttar Pradesh	245	121.21
27	Uttarakhand	NA	NA
28	West Bengal	10000**	37.00**
	Total	**56539**	**13155.89**

*Under Verification

Source: MOWR, Govt. of India, 2007

**Under MI, RIDF S

Initiatives by DoWR, Govt. of West Bengal- WBADMIP

In West Bengal, the number of WUAs was 10000 covering an area of around 37 thousand ha and contributing around 0.7% to total area due to lack of functional grants till the end of XI Five Year Plan (2012).

However, during 12th Five-Year Plan, Government of West Bengal took up an initiative to include the concept of IMT through launching of West Bengal Accelerated Development of Minor Irrigation Project (WBADMIP) leading to a formation of around additional 848 (WUAs) covering 25499 ha command area with 50265 beneficiaries by the end of July 2015.

Progress of IMT under West Bengal Accelerated Development of Minor Irrigation Project (WBADMIP)

Sl. No.	District	Area (ha)	Number of WUA formed	No of WUAs Registered	No. of potential beneficiaries
1	Bankura	2192	74	65	2310
2	Barddhaman	1540	63	15	3809
3	Birbhum	982	88	57	3292
4	Dakshin Dinajpur	1646	62	48	1456
5	Darjeeling	356	5	1	253
6	Howrah	315	16	16	1715
7	Hooghly	457	15	15	1730
8	Jalpaiguri	2878	91	69	3381
9	Coochbehar	2367	73	35	2139
10	Malda	1816	50	40	3418
11	Murshidabad	768	18	18	2272
12	Nadia	556	29	9	1108
13	North 24 Parganas	883	22	21	3392
14	Paschim Midnapore	1904	53	34	3825
15	Purba Midnapore	2660	40	40	6744
16	Purulia	1216	79	24	2552
17	South 24 Parganas	963	17	17	2505
18	Uttar Dinajpur	2000	47	46	4364
	Grand Total	25499	848	570	50265

Source: DoWR, Govt. of West Bengal, 2016

With this back ground it is proposed to undertake research on **Performance Assessment of Farmers Managed Minor Irrigation Systems in West Bengal**

Objectives of study:

1. To study the profile of water user associations (WUAs) and their member-farmers under different types of minor irrigation systems.
2. To evaluate performance of irrigation under the jurisdiction of selected WUAs as perceived by the member-farmers.
3. To assess the agricultural performance in command areas under different minor irrigations systems.
4. To elicit the extent of farmers' participation in irrigation management.
5. To study the effectiveness of WUAs in irrigation management and factors influencing it.
6. To explore the constraints faced by the farmers in managing the irrigation system and suggest the remedial measures.

ii. REVIEW OF LITERATURE

- Hamdy and Lacirignola (1997) WUAs can contribute to better irrigation system performance because of their advantages over a public agency, on the one hand, and over uncoordinated activity by individuals, on the other.

- Samad and Vermillion, (1999) revealed that WUAs ensures voluntary and active involvement of farmers in all decisions and activities related to the irrigation water management programme. It develops a process and group dynamics in which affected populations collectively discuss and work out ways and means to tackle their own problems rather than waiting for others to do it for them.

- Anbumozhi *et al.* (2001) reported by implementing the modernization programme in minor irrigation tanks in the state of Tamil Nadu, improvement in conveyance, distribution, application and irrigation efficiencies resulted in increase in paddy yield, water productivity and gross income.

- Gandhi and Namboodiri (2002) reported that in past two decades farmers have started actively participating in the irrigation management and thereby marked improvement in water utilization efficiency.

- Prasad (2004) concluded that farmers of middle aged group are actively involved in maintaining the systems of minor irrigations and grab better opportunities of training for imparting participatory management awareness, knowledge and required skills.

- McKay and Keremane (2006) reported that that the WUA has been successful in devising and enforcing the rules for water distribution, fee collection and conflict resolution for over a decade in the Mula irrigation system in the state of Maharashtra.

- Kumar (2007) reported around 80% of the farmers in India belong to small and marginal category and a very small fraction of them own wells and pump sets. Against this, less than 1% of the farmers are large holders and around 69% of the large farmers own wells and pump sets. So there exists a large inequity in access to groundwater abstraction structures.

- Ghosh *et al*. (2010) revealed a contrasting impact of Participatory Irrigation Management program as the concerning WUA to be more effective in case of minor project where as it is weak in case of major and medium projects in the state of Odisha.

- Fadul *et al.* (2012) concluded the active participation of women is a crucial factor for better operation and maintenance, enforcement of rules and regulations, and improved irrigation management.

- Methi, C.B. (2012) reported a positive significant impact on irrigation water availability, agricultural scenario and capacity building is seen among the farming community in managing the irrigation system.

- Mukherji *et al*. (2013) concluded that the rate of growth of India's groundwater structures is slowing down. In states like Karnataka, Tamil Nadu, Rajasthan, Andhra Pradesh and Gujarat, water is a major constraint in expanding well irrigation. In contrast to this, in states such as West Bengal, Bihar and Assam, land is a constraint in irrigated area expansion.

- L.A. Ngirazie *et.al.* (2014) reported that in many countries, water user associations (WUAs) have assumed responsibility for managing irrigation systems, but their performance is known to vary markedly. Overall, performance was found to be average, but with wide variation between individual WUAs.

III. RESEARCH METHODOLOGY

Present investigation will follow an ex-post facto research design with following Hypotheses:

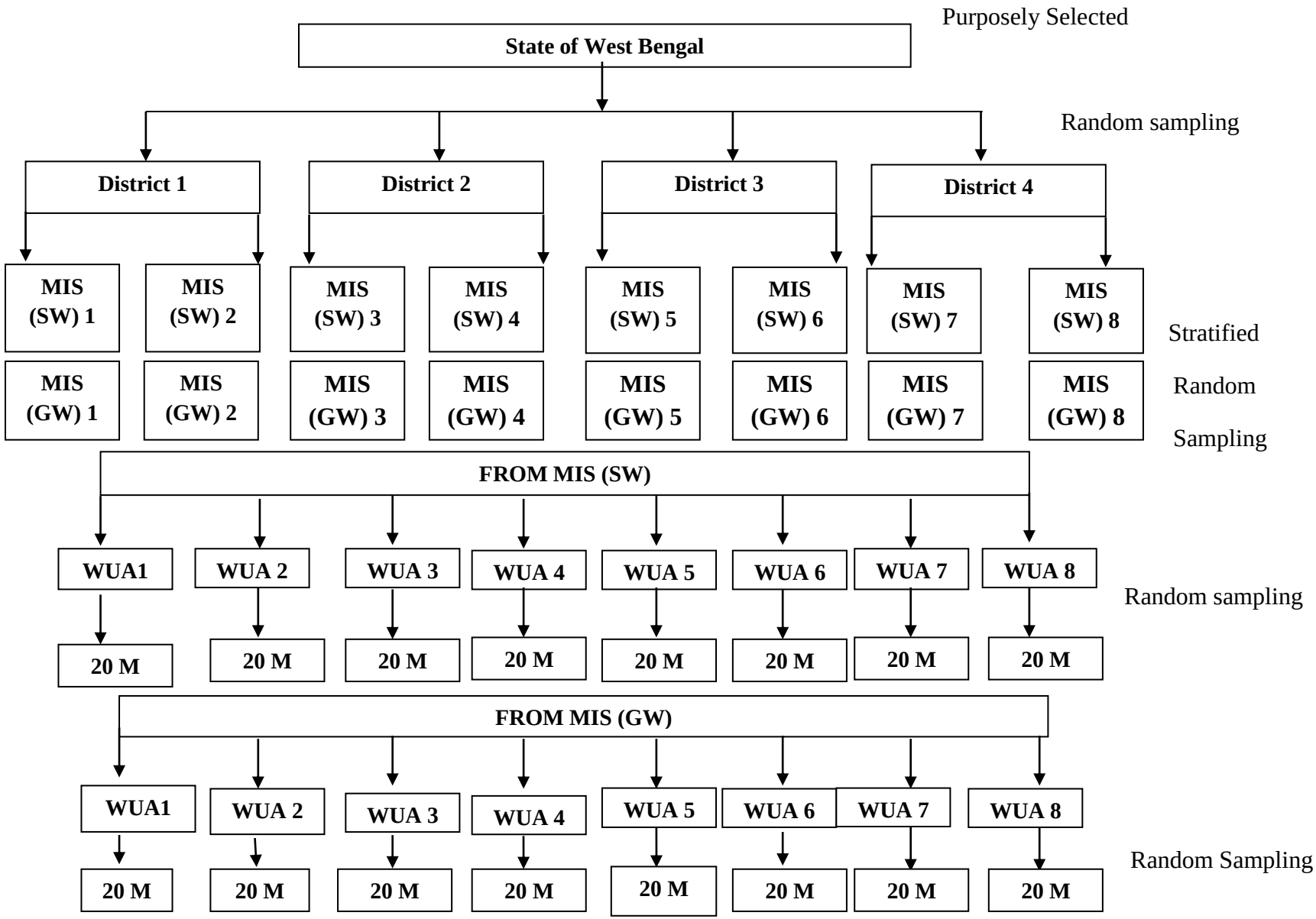
H_0: No impact of IMT to WUAs on Irrigation and Agricultural performance

H_1: IMT to WUAs improved Irrigation and Agricultural performance

The brief descriptions of methodology are presented on:

- ❖ Sampling Plan
- ❖ Variables and their Measurement
- ❖ Method of Data Collection
- ❖ Statistical Analyses

Sampling Design



A total of 320member-farmers representing 16 WUAS will be selected as respondents.

Variables and their Measurements

1a. Profile of Water User Associations (WUAs) under MIS (SW) and MIS (GW):

- WUA's formation process
- WUA's composition and its executive committee members
- Matrix of members by location of their land at the command area
- Powers and Responsibilities of WUAs
- WUA's functioning (awareness of member-farmers on WUA and its activities, individual member-farmer's role, election process, meetings, decision making, operation and maintenance of the irrigation infrastructure, etc)

A Semi-structured Interview Schedule will be developed to record and measure the above-mentioned aspects at individual WUA level

1b. Profile of Member –Farmers of WUA

Variables		**Measurement**
Socio-personal		
1	Age	On the basis of chronological age
2	Sex	Categorized as male and female
3	Education level	Scale developed by Pareek and Trivedi(1964)
4	Family size	Scale developed by Pareek and Trivedi (1964)
5	Occupation	Structured schedule will be developed
Socio-economic		
1	Size of holding	Structured schedule will be developed
2	Economic status	Structured schedule will be developed
3	Annual income from agriculture/ farming	Structured schedule will be developed
4	Annual income from other sources	Structured schedule will be developed

Socio- psychological		
1	Economic motivation	Scale developed by Moulik (1965)
3	Independency	Scale developed by Supe (1969)
4	Scientific orientation	Scale developed by Supe (1969)
5	Social participation	Structured schedule will be developed
Communication profile		
1	Mass media exposure	Scale developed by Singh (1972)
2	Contact with personal cosmopolite	Scale developed by Singh (1972)
3	Contact with personal localites	Scale developed by Singh (1972)

2. Performance of Irrigation in Command of MIS (WUA's Jurisdiction)

The irrigation performance will be assessed on following variables:

- **Tractability:** Quantity of water supply / adequacy (no. of irrigations requested and those actually received), Point of water delivery (distance of field from outlet), Stream size, Flow rate of water, Control mechanism to regulate the flow in outlet
- **Convenience:** Timeliness of irrigation (no. of irrigations requested and those received on time), Timing of water arrival, Duration of water supply, Frequency of getting water (interval between two irrigations)
- **Predictability:** Knowledge of water supply roster / advance, water supply roster, Management decisions / farming operations influenced by water supply, Certainty of water availability.

A scale will be developed to measure the Irrigation Performance from Farmers' Perspectives based on various variables and parameters under each variable.

3. Agricultural Performance in command of MIS (WUAs Jurisdiction)

- **Cropping pattern -** Season wise crops grown by the farmers and area under each crop
- **Cropping intensity -** Season wise cropped area out of designed command area
- **Crop productivity -** Crop wise average production per unit area in both wet and dry seasons
- **Inputs utilization pattern** - Labour, seeds, fertilizers, plant protection chemicals, etc
- **Land utilization/ extent of intensification - Crop** wise land area with duration of each crop in each season.
- **Multiple cropping / crop rotation-**Specific crop area in each calendar year in comparison to total crop cultivable area available.
- **Crop diversity, net income, remunerative cropping sequence -**Cost of production, crop wise specific gross revenue and total gross revenue generated by all the crop enterprises under different crop sequences in single year.

A Structured Interview Schedule will be developed to measure the Agricultural Performance from Farmers' Perspectives based on various variables.

4. Extent of Participation of Member-Farmers in WUA's Activities/ Functions:

- Farmers-members' participation in different activities undertaken by WUA will be studied with the help of a Farmers' Participation Index (FPI)

$$FPI = \frac{\text{Mean participation score}}{\text{Maximum participation score}} \times 100$$

where, mean participation score = $\Sigma P_i / N$ and $P_i = \Sigma PP_j$

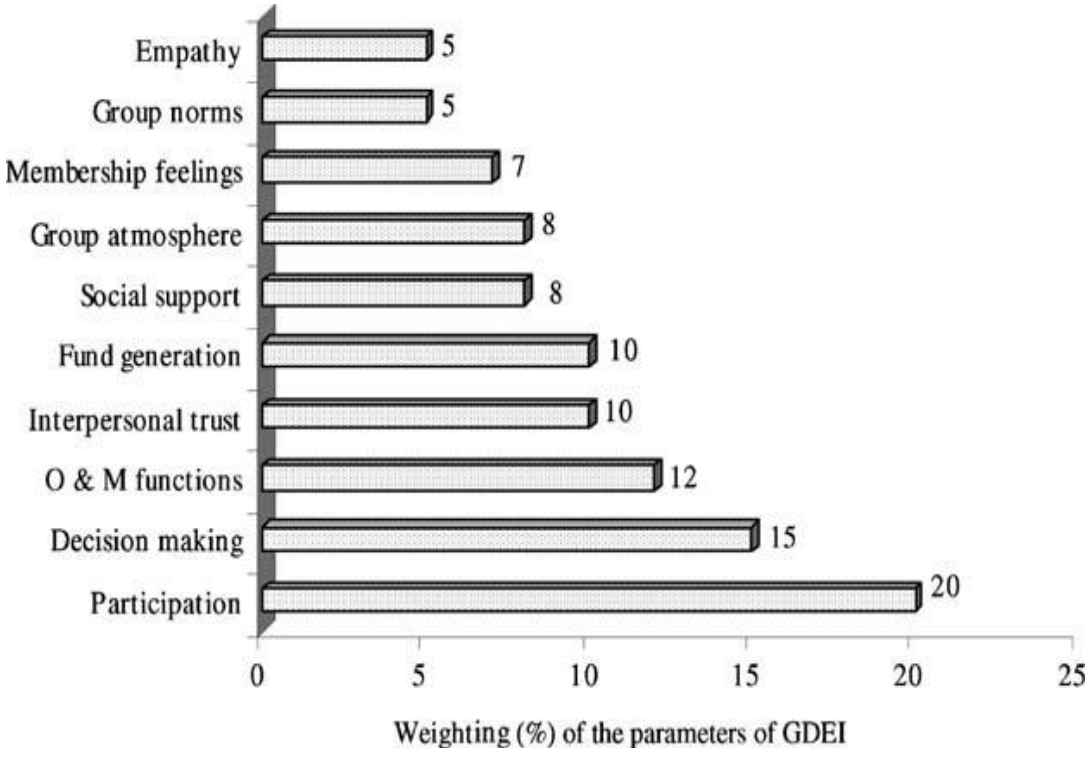
PP_j = Total score of farmers' participation

i = 1,2, ……, N and j = 1,2, ……, K

N and K = total number of respondents and total number of activities, respectively.

5. Effectiveness of WUAs in Irrigation Management

Effectiveness of different water user associations will be measured on 10 different variables with the help of water users' group dynamics and effectiveness index developed by Ghosh *et al.* (2010)



Water users' group dynamics and effectiveness index =

0.20*P+0.15*D+0.12*O+0.10*T+0.10*F+0.08*S+0.08*A+0.07*M+0.05*N+0.05*E

6. Constraints Faced by the Farmers in Managing the Irrigation System and Remedial Measures

- Technical Constraints
- Infrastructural Constraints
- Administrative Constraints
- Economic Constraints

A Problem Tree and Solution Tree will be developed based on Focus Group Discussion and Semi-structured Interview Schedule Survey at WUA Level and Member-Farmers level, respectively will to delineate the Constraints and Remedial Measures.

Method of Data Collection

Data will be collected at two levels:

1. WUA Level
2. Member-farmers Level

With different Methods:

(a) Semi-structured Interview Schedule

(b) Structured Interview Schedule

(c) Focus Group Discussion

Statistical Analyses

Depending on the distribution pattern of the data i.e., whether normally distributed or not, statistical analysis will be undertaken. If the data is normally distributed as evident from the test of normality, the parametric statistical analysis will be done. If the data are not normally distributed the non parametric statistical analysis will be carried out.

Parametric Statistics

- **Descriptive Statistics:** Frequency, Percentage, Mean, Standard Deviation ,Rank, Indexes etc.
- **Inferential Statistics:** Correlation, Regression, Factor Analyses etc.

Or

Non parametric Statistics: Kendall coefficient of concordance, Mann - Whitney U- Test, Wilcoxon Sign test etc.

Expected Outcome

- The study will unveil the process and impact of IMT in management of MIS and their extent
- The analyses of performance of irrigation service would reveal certain issues which need attention for making the MIS further efficient.
- The agriculture performance assessment would be vital indicator to understand the output of the process that is IMT and farmers' participation.
- The level of satisfaction of the farmers and the factors influencing farmers' attitude towards IMT to WUA would provide feedback about the success and/or failure of the initiative.
- A look into the performance of WUAs from member-farmers' perspectives would reflect the sustainability issue and hindrances to it, if any.

Implications

The results of this study will be based on the perceptions of the WUA member-farmers, who are directly involved in the processes of the IMT. The suggestive findings of this study can, therefore, be used to mitigate respective problem areas and bottlenecks and thus, "prevent the grass-root level irrigation management institution from being temporary / disappear /decline/ stagnate" through policy advocacies in future management of irrigation infrastructure in general and minor irrigation in particular.

References

Anbumozhi1 V, Matsumoto K, Yamaji1 E. (2001). Towards improved performance of irrigation tanks in semi-arid regions of India: modernization opportunities and challenges. Irrigation and Drainage Systems 15: 293–309.

Fadul Bashir, E. M., Bashir, E. E., Bushara, A. I., & Haile, A. M. (2012). Sharing the experiences among water users associations in spate irrigated schemes (Regional workshop report). Kassala: Hydraulics Research Centre.

Gandhi Vasant P. and N. V. Namboodiri (2002), Participatory Irrigation Management in India: An Evaluation Of Performance in Andhra Pradesh, Gujrat and Maharashtra, CMA Publication No. 237.

Ghosh S., Kumar A., Nanda P. and Anand P.S.B. (2010). Group dynamics effectiveness of water user associations under different irrigation systems in an eastern India state. *Irrigation and Drainage, 59: 559–574.*

Hamdy A. and Lacirignola C. (1997). Water Users Associations and Sustainability Of Irrigation Systems, 97(3), 4-9.

International Water Management Institute (http://www.iwmi.cgiar.org/)

Kumar, M Dinesh (2007): Groundwater Management in India: Physical, Institutional and Policy Alternatives (New Delhi: Sage Publications).

McKay J, Keremane GB. (2006). Farmers' perception on self created water management rules in a pioneer scheme: the Mula irrigation scheme, India. *Irrigation and Drainage Systems*, 20: 205–223.

Meti, C.B.(2012). Studies on factors influencing drip irrigation adoption, constraints andremedial measures to increase area under drip irrigation. *International Journal of Agricultural Engineering, 5(2), 236-239.*

Ministry of Water Resources (2002). National Water Policy. Government of India, New Delhi.

Ministry of Water Resources (CWC). (2012). *Water and Related Statistics*. Central Water Commission: New Delhi, India.

Mukherji, Aditi, Stuti Rawat and Tushaar Shah (2013): "Major Insights from India's Minor Irrigation Censuses: 1986-87 to 2006-07", *Economic & Political Weekly, Vol XLVIII (28 & 29): 115-24.*

Parthasarathy R. (2000). Participatory irrigation management programme: institutional and financial issues. *Economic and Political Weekly, Aug.-Sept.*, 3147-3154.

Prasad, D. R., (2004). Participation of partners in agricultural Research extension and farmers linkage mechanisms in Krishna Godavari Zone of Andhra Pradesh, Ph.D. (Agri.) Thesis, A.N.G.R. Agric. Univ., Hyderabad (India).

Srivastava SK., Ghosh S., Kumar A., and Brahmanand PS. (2014). Unraveling the spatio-temporal pattern of irrigation development and its impact on Indian agriculture. *Irrigation and Drainage*, 63: 1–11.